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RESEARCH PAPER

REGIONAL VARIATION IN AGE AT FIRST MARRIAGE AMONG WOMEN OF REPRODUCTIVE AGE IN NIGERIA.

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ABSTRACT

The society and the environment have great influence on the attitudes and the decisions made by her residents. The age at which a woman enters marriage to some extent is influenced by the society and the environment she lives in and some other socio-demographic factors. This study employs a hierarchical survival analysis which account for state differences in the age at first marriage among Nigerian women using the dataset from 2018 National Demographic Health survey. The Cox model with two independent random effects was used to provide parameter estimates as well as estimates of the random effects variances at all the levels. It was found that state heterogeneity had the highest contribution and location of residence within the state also contributed to the differences in the timing of marriage. The study also revealed that region, location of residence, wealth index, respondent age at first sex, birth cohort, religious affiliation and educational qualification of the women were significant factors in determining the age at first marriage.

Keywords*:* heterogeneity, cluster, random effects, AIC, age at first marriage.

INTRODUCTION

Marriage is considered an important institution both for the individual and the society at large. It is a significant event that marks the beginning of the formation process of a family and child bearing. Marriage marks the beginning of transition to adulthood as the individual separates from the parental home, even if they continue to be socially and economically interdependent through the extended family. The ages at which individuals enters marriage contributes greatly to fertility as the timing a woman enters marriage determines the time to have children and the total number of children they will have over their lifetime (Islam, 2009; Godha, 2013; Ajala, 2014; Singh & Maheshwari, 2014; Global Health Metrics, 2018; Shakya, *et. al*., 2020). The timing of first marriage or union also have implication on their social status, women who marry at a younger age are likely to find motherhood as the sole focus of their lives at the expense of developing in other areas of their lives such as training for employment, work experience, formal education and personal growth (Susheela & Renee, 1996; Zahangir & Kamal 2011; Chau-Kuang, *et. al*., 2013; Kamal *et. al*., 2015; Arnab & Siraj, 2020).

The differences in age at first marriage is not uniform among all women. Age at first marriage among women differs between different cultures, from one region to another and even among different groups of people (Glick & Landau, 1950; Bongaarts, 2007; Indongo & Pazvakawamba, 2015; Odimegwu, *et al*., 2015; Farooq & Deen, 2016). Spatial demographers assume that location of residence is an important determinant of attitudes and behaviours, both because geographic features can restrain or facilitate behaviours and it is through spatial clustering of people that clustering of norms typically occurs (Week, 2004; Week, 2016). Therefore, the different groupings, communities and clusters of individuals is also of interest in investigating the variations in the ages at which individual women enters marriage (Biswas, *et al*., 2019).

Nigeria been the most populous Africa Country with over 521 languages, over 1150 dialects and ethnic groups scattered in the 36 states within the six geopolitical zone cannot be said to have uniformity in the ages at which her women enter marriage due to the great diversity inherent in her. Issues relating to early marriage could be seen as a general problem affecting all regions and group of people in the country with her diversity. Studies have explored the factors associated with age at first marriage among women of reproductive age (*Obikeze & Okeibunor, 2002;* Adebowale, *et al*., 2012; Efobi, *et al*., 2021; Bolarinwa, *et al*., 2022; Bolarinwa, *et al*., 2022; Rasul, *et al*., 2022). Despite these studies, the variation that exist in the age at which marriage is initiated between the different region of residence of the women have not been examined in a survival analysis setting. The environment, group and location of one's residence has a great influence on the attitudes and involvements of an individual. Therefore, the goal of this paper is to investigate the variation in age at first marriage among the states and other factors that may be associated with it among the women of reproductive age in Nigeria while controlling for the individual women characteristics. In other words, we want to identify and estimate the variations from the location and or state of residence as a factor influencing age at first marriage. The knowledge of these state differences is a critical step in identifying and addressing issues related to building women socioeconomic capacities for nation's development.

This paper is organized as follows; the data source and the variables description as well as the methodology intended to achieve the set objective are discussed under the materials and method section. The result of the analysis and the discussions are presented in the result

and discussion section while the conclusion includes the findings from the work, limitation of the work and the suggestions to curb the menace of early marriage among Nigeria women.

MATERIALS AND METHOD

Data source and variables description

Dataset from the 2018 Nigeria Demographic and Health Survey (NDHS) were analysed. Individual data were available for 41465 women aged 15-49. The survey was designed to provide information on age at first marriage of the women at national, regional and state for both urban and rural areas. The socio demographic and economic factors considered to affect the age at the first marriage as made available in the dataset are religion (Islam and Christianity), highest educational qualification (no education, primary, secondary, higher), birth cohort (less than 20, 20-29, 30-39, 40-49), age at sex (at marriage, before marriage, never had sex), wealth index (poor, middle, rich), geo-political zone (North central, North east, North west, South east, South-south, South west) and location of residence (urban, rural). The first categories are the reference categories for all the factors. The selection of these variables is based on the available information of the NDHS data and women individual factors considered to affect the timing of marriage.

Proposed Approach

Survival time models often assume that subjects in a population are homogeneous conditional on observed factors (covariates) and therefore assume that the random components at the contextual level are independent. The Cox proportional hazard model assumes independence of survival times thereby ignoring the effect of the clusters that the subjects belong to which could be of interest at it affects the event times. Ignoring clustering when it exist could lead to biases not only the regression estimates but also their standard errors. Several estimation procedures have been proposed to model Cox with two additive random effects which is capable of handling the random effect at the group level and at the individual level Xue and Brookmeyer (1996), Ripatti and Palmgren (2000), Duchateau and Janssen (2008) and Wienke (2010).

Two additive random effects Cox models framework

Suppose there are G-independent clusters (i = 1, ..., G) T_{ij} is the survival times for subject j (j = 1, ...,n_i)from group I and C_{ij} is the corresponding right censoring time. Assuming the censoring times are independent of the survival times, the observations are Y_{ij} = min (T_{ij}, C_{ij}) and the censoring indicator $\delta_{ij}=I_{\{Tij\leq Cij\}}$. For each subject, the explanatory variable x_{ij} is observed. The hazard for the *jth* subject in the *ith* cluster with random group effect b_{i0} (i.e. hazard for the *jth* subject in the *ith* cluster that takes into account the correlation occurring in the data due to clustering with random cluster effects) is given by

$$h_{ij}(t\backslash b_{i0}, X_{ij}) = h_0(t)exp(b_{i0} + \sum_{k=1}^{p} \beta_k X_{ijk}) \qquad 1$$

where h_0 is the unspecified baseline hazard function at time t, β is the fixed effect parameter, b_{i0} is the random effect for the *ith* cluster. The random effects b_{i0} are assumed to be independently and identically distributed.

When variation between the cluster exists and is large, there is need to investigate whether there is variation in the predictor effect between the clusters. To achieve this, an extra random effect is added to the model in Eq. (1) which is the interaction between the observable and the unobservable variables. Then, the Cox model with two additive random effect models is expressed as;

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$$h_{ij}(t\backslash b_{i0}, b_{i1}) = h_0(t)exp\left(b_{i0} + b_{i1}x_{ij1} + \sum_{k=1}^{p}\beta_k x_{ijk}\right) \quad 2$$

where b_{i1} is the random predictor effect also known as random coefficient or random interaction. The random effects are assumed to follow a multivariate normal distribution with mean 0 and a variance-covariance matrix Σ,

$$f(b_{i0}, b_{i1}) \sim N(0, \Sigma) \text{ with } \Sigma = \begin{bmatrix} \sigma_0^2 & \sigma_{01} \\ \sigma_{10} & \sigma_1^2 \end{bmatrix}.$$

The variance σ_0^2 of the b_{i0} represents the heterogeneity between the clusters of the overall baseline hazard and the variance σ_1^2 of b_{i1} is the heterogeneity between clusters of the overall effect β_1. If the variance σ_0^2 is null, then the observations from the same cluster are independent. A larger variance indicates greater heterogeneity across clusters and a greater correlation of the survival times for subjects belonging to the same cluster. A null σ_1^2 implies no heterogeneity of the effect over clusters.

Given the random effects (b_{i0},b_{i1}), observations within cluster *i* are assumed to be independent. The full marginal log likelihood function for cluster *i* is given as;

$$l(h_0(t), \beta | b_{I0}, b_{i1}) = ln \prod_{i=1}^{G} \int \int \left[\prod_{j=1}^{n_i} h(T_{ij}|b_{i0}, b_{i1}, x_{ij})^{\delta_{ij}} s(T_{ij}|b_{i0}, b_{i1}, x_{ij}) \right] f(b_{i0}, b_{i1}) db_{i0} b_{i1}$$

$$= \sum_{i=1}^{G} ln \int \int L_i^c(h_0(.), \beta | b_{i0} b_{i1}) f(b_{i0}, b_{i1}) db_{i0} b_{i1}$$

The conditional likelihood function for cluster *i* is

$$L_i^c(h_0(.), \beta, b_{i0}, b_{i1}) = \prod_{j=1}^{n_{ij}} h(T_{ij}|b_{i0}, b_{i1}, x_{ij})^{\delta_{ij}} s(T_{ij}|b_{i0}, b_{i1}, x_{ij}) \quad 3$$

where

$$S_{ij}(T_{ij}|b_{i0}, b_{i1}, x_{ij}) = exp\left[-H_0(t_{ij}|b_{i0}, b_{i1}) exp(b_{i0} + \beta x_{ij} + b_{i1}x_{ij})\right]$$

Assuming the conditional independence of observation within a cluster and independence between clusters, the overall marginal likelihood function can be written as,

$$l(h_0(.), \beta, \Sigma) = \sum_{i=1}^{G} ln \int \int exp\{-K_i(b_{i0}, b_{i1})\} db_{i0} db_{i1} \quad 4$$

where

$$K_i(b_{i0}, b_{i1}) = -ln\left(L_i^c(h_0(.), \beta | b_{i0}, b_{i1})\right) - ln\left(f(b_{i0}, b_{i1})\right)$$

When the correlation structure for the two random effects is modelled by$(b_{i0}, b_{i1}) \sim N(0, \Sigma)$, we have

$$f(b_{i0}, b_{i1}) = \frac{1}{(2\pi)(det\Sigma)^{1/2}} exp\left[-\frac{1}{2}(b_{i0}, b_{i1})\Sigma^{-1}(b_{i0}, b_{i1})'\right]$$

Hence, we obtain for $K_i(b_{i0}, b_{i1})$:

$$K_i(b_{i0}, b_{i1}) = -ln\big(L_i^c(h_0(.), \beta | b_{i0}, b_{i1})\big) - ln\big(f(b_{i0}, b_{i1})\big)$$

$$= \sum_{j=1}^{n_i}\left[\delta_{ij}\{\ln h_0(t_{ij}) + b_{i0} + b_{i1}x_{ij} + \beta x_{ij}\} - H_0(t_{ij})exp(b_{i0} + b_{i1}x_{ij} + \beta x_{ij})\right]$$

$$= ln(2\pi) + \frac{1}{2}(det\Sigma) + \frac{1}{2}(b_{i0}, b_{i1})\Sigma^{-1}(b_{i0}, b_{i1})'$$

With $H_{ij}(.) = \int h_{ij}(t)dt$ the cumulative hazard function and $H_{ij}(.|b_{i0}, b_{i1}) = H_{ij}(.)exp(b_{i0} + b_{i1}x_{ij})exp(\beta x_{ij})$ the conditional cumulative hazard function and $det\Sigma = \sigma_0^2\sigma_1^2(1-\rho^2)$ and

The marginal log-likelihood in Eq. (4) cannot be used as it were to estimate the parameters of model Eq. (2) because of unspecified parameter of the baseline hazard which depends on integrations that cannot be solved analytically. The Penalized partial likelihood is considered in work to estimate the parameters of the Cox model with two additive random effects.

Penalized Partial Likelihood Procedure

This estimation procedure was proposed by Ripatti and Palmgren (2000). Ripatti and Palmgren (2000) followed Breslow and Clayton (1993) in their approach for GLMM with normal random effects and applied Laplace's method for integral approximation (1.4) which leads to the approximate marginal log-likelihood by

$$l(h_0(.), \beta, \Sigma) \approx \frac{1}{2}\ln|\Sigma| - \frac{1}{2}ln\left|\left(\frac{\partial^2 K_i(b_{i0}, b_{i1})}{\partial b_{i0}\partial b_{i1}}|_{(\tilde{b}_{i0}, \tilde{b}_{i1})}\right)\right| + \sum_{j=1}^{n_i}\left[\delta_{ij}\left[lnh_0(t_{ij}) + \tilde{b}_{i0} + \beta x_{ij} + \tilde{b}_{i1}x_{ij}\right] - H_0(t_{ij})exp(\tilde{b}_{i0} + \beta x_{ij} + \tilde{b}_{i1}x_{ij})\right] - \frac{1}{2}(\tilde{b}_{i0}, \tilde{b}_{i1})\Sigma^{-1}(\tilde{b}_{i0}, \tilde{b}_{i1})' \quad 5$$

where $(\tilde{b}_{i0}, \tilde{b}_{i1}) = \underset{(b_{i0}, b_{i1})\epsilon R^2}{\arg max} K_i(\tilde{b}_{i0}, \tilde{b}_{i1})$

If both Σ were known and (b_{i0}, b_{i1}) were considered fixed effects parameters, then the second line in Eq. (5) is penalized Cox full log likelihood (Green, 1987), where the last term in Eq. (5) is the penalty term penalizing for extreme values b_{i0}, b_{i1} and b_{i1}, and are set of parameters and a penalty term, it turns out that it can be maximized using penalized fixed effects partial likelihood (PPL),

$$
\begin{aligned}
l_i^{PEN}(h_0(.),\beta,\Sigma,b_{i0},b_{i1}) &= \sum_{j=1}^{n_i}\delta_{ij}\left[b_{i0}+\beta x_{ij}+b_{i1}x_{ij}-ln\sum_{(p,q)\epsilon R(t_{ij})}exp\left(b_{p0}+\beta x_{pq}+b_{p1}x_{pq}\right)\right] \\
&-\frac{1}{2}\left(\tilde{b}_{i0},\tilde{b}_{i1}\right)\Sigma^{-1}\left(\tilde{b}_{i0},\tilde{b}_{i1}\right)' \\
&+\sum_{j=1}^{n_i}\delta_{ij}\left[ln\left(h_0\left(t_{ij}\right)\right)+ln\sum exp\left(b_{p0}+\beta x_{pq}+b_{p1}x_{pq}\right)\right] \\
&-H_0\left(t_{ij}\right)exp\left(b_{i0}+\beta x_{ij}+b_{i1}x_{ij}\right) \\
&= l_i^{PPL}(\beta,\Sigma,b_{i0},b_{i1})+g\left(h_0\left(t_{ij}\right),\beta,b_{i0},b_{i1}\right)
\end{aligned}
$$

where $R(t_{ij})$ are the risk sets.

Application to Data on Age at First Marriage

The age at first marriage of the women were recorded and if the woman has not yet married as at the time of the survey, the current age was recorded as censored observation. The hierarchical structure of the dataset as used in this study is therefore described as follows

State level: Each woman belongs to one of the 37 distinct geographical locations that represent the states.

Individual level: The woman is considered the lower level and the unit of analysis in this study.

Survival information collected on the *ith* woman from the *jth* state indexed as $(t_{ij},\delta_{ij}(t))$, (i=1,…,41465), j=(1,…,37), where t_{ij} is the age at first marriage and δ_{ij} is the censoring indicator which takes the value 1 if i woman from state j has married and 0 if otherwise. Then, the Cox model with random state effect model is expressed as;

$$h_{ij}\left(t|b_{i0},x_{ij}\right)=h_0(t)exp\left(b_{state}+\sum_{k=1}^{p}\beta_k x_{ij}\right) \quad 6$$

When variation between the states exists and is large, there is need to investigate whether there is variation in the predictor effect between the states. To achieve this, an extra random effect is added to model (6) which is the interaction between the observable and the unobservable variables. Then, the Cox model with two additive random effect models is expressed as;

$$h_{ij}\left(t|b_{i0},b_{i1},x_{ij}\right)=h_0(t)exp\left(b_{state}+b_{woman}x_{g1}\sum_{k=1}^{p}\beta_k x_{ij}\right) \quad 7$$

where b_{woman} is the random predictor effect also known as random coefficient or random interaction. The variance σ_0^2 of the b_{state} represents the heterogeneity between the states of the overall baseline hazard and the variance of is the heterogeneity between states of the overall effect β1. If the variance σ_0^2 is null, then the observations from the same state are independent. A larger variance indicates greater heterogeneity across states and a greater correlation of the survival times for subjects belonging to the same state. A null σ_1^2 implies no heterogeneity of the effect over clusters.

The observed factors included in this study are the religion of the woman, place of residence, level of education, geopolitical zone, age at first sex, wealth index and birth cohort.

RESULT AND DISCUSSION

Results

Fig 1 presents the map of Nigeria with the median age at marriage in each state. In order words, the median ages represent the age at which fifty percent of the population of the women in each state get married. The least median age at marriage is 15 years while the maximum median age at marriage is 23 years. Half of the population of women from Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe and Zamfara states marries at age 15 while fifty percent of the women from Abia, Imo and Lagos states women delayed marriage till 23 years. It is evident from Fig 1 that early marriage is predominant in the Northern part of the country than other regions. This further emphasises the need to investigate the regional/state variation in the ages at which marriage is initiated among Nigeria women.

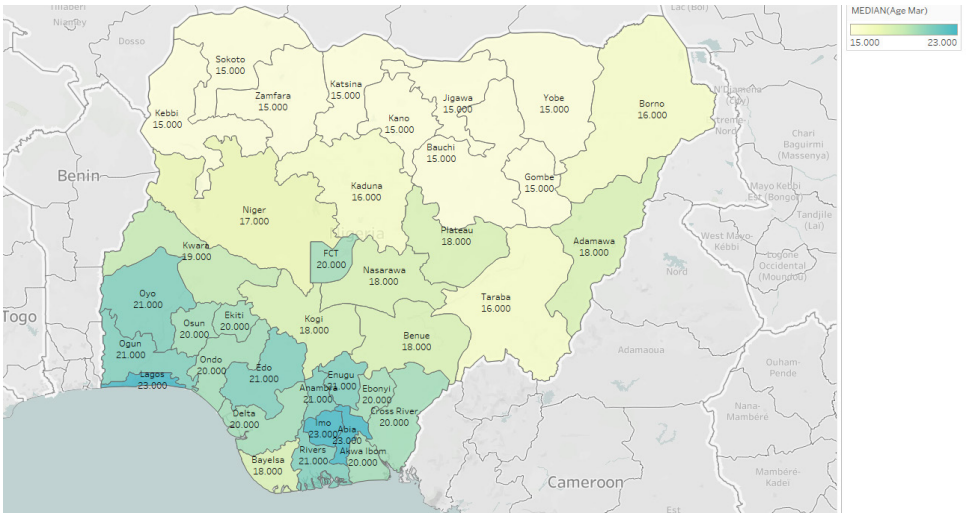

Fig 1: Nigeria map with the median age at first marriage for each state.

Two additive random effects Cox model on age at first marriage

The estimates of the coefficient, hazard ratio and p-values for two additive random effects Cox model are presented in Table 1. From Table 1, all the factors considered were found to be significant in determining the timing to marriage. As observed, Christian women are 25% less likely to marry earlier than Muslim women (HR=0.7528). Women who have primary education are 13% less likely to marry early compared to women with no education (HR=0.8666), also, women with at least a secondary education are 42% less likely to experience early marriage (HR=0.5790) while women with higher education are 67% not likely to marry early compared to women with no education (HR=0.3313).

Table 1: Estimated Coefficient, Hazard Ratio and P-value

Factors	Coef. (SE)	Haz. Ratio	P-value
Religion			
Christian	-0.2840 (0.0188)	0.7528	<0.0001
Highest Educational Qualification			
Primary	-0.1431 (0.0186)	0.8666	<0.0001
Secondary	-0.5464 (0.0188)	0.5790	<0.0001
Higher	-1.1048 (0.0263)	0.3313	<0.0001
Birth Cohort			
20-29 years	-0.1781 (0.0257)	0.8368	<0.0001
30-39 years	-0.2676 (0.0262)	0.7652	<0.0001
40-49 years	-0.3676 (0.0272)	0.6923	<0.0001
Age at first sex			
Before marriage	-1.3923 (0.0142)	0.2485	<0.0001
Never had sex	-8.1169 (0.5776)	0.0003	<0.0001
Wealth Index			
Middle	-0.0640 (0.0171)	0.9380	0.0002
Rich	-0.1298 (0.0192)	0.8783	<0.0001
Geo-political Zone			
North-east	0.0396 (0.0801)	1.0404	<0.0001
North-west	0.1881 (0.0770)	1.2070	<0.0001
South-east	-0.1755 (0.0849)	0.8390	0.0390
South-south	0.0047 (0.0814)	1.0047	0.9500
South-west	-0.1133 (0.0807)	0.8929	0.1600
Location of Residence			
Rural	0.0825 (0.0274)	1.0860	<0.0001
Random effects			
Group	**Variable**	**Std. Dev.**	**Variance**
State/Rural	**Intercept**	0.0943	0.0089
State	**Intercept**	0.1205	0.0145

Women whose current ages are in the interval 20-29 years are 16% less likely marry earlier (HR=0.8368), women whose current ages are in the interval 30-39 years are 23% less likely to experience early marriage (HR=0.7652) while women whose current age are between the interval 40-49 years are 30% less likely to marry earlier (HR=0.6924) compare to women whose current age is less than 20 years.

Women who initiated sex before marriage are 75% less likely to marry earlier (HR=0.2485)

while women who never has sex are 99% less likely to marry early (HR=0.0002) compare to women who had their first sexual experience at their marriage. Women characterized with middle class wealth index are 6% less likely to marry earlier (HR=0.9380) while rich women are 12% less likely to initiate marriage earlier than women who are poor (HR=0.8783).

Women from the Northeast and Northwest are more likely to marry early compared to women from North central (HR=1.0404 and 1.2070) respectively. South east women are 16% less likely to marry earlier compare to women from the North central. The estimated hazard ratio for South-south and South west are not statistically significant. Women living in the rural areas are more likely to marry early compared to women residing in the urban areas (HR=1.0860).

Investigating the regional differences, the estimated parameter of the random effect presented in Table 1, for the random state effect, an estimated intercept (excess risk) for each state, has a standard deviation of 0.12. It is expected that state of residence has risk effect of times on the ages at which marriage is initiated. To look at the random location of residence (rural/urban) effect within the state, an estimated intercept (excess risk), has a standard deviation of 0.09, which implies that location of residence within the state have times risk effect on the ages at which marriage is initiated. The state heterogeneity has a greater risk on the age at first marriage compared to the location of residence within the state.

Discussion

Results of the findings shows that early marriage is prevalent among Muslim women which was also revealed in the result from the Northern part of the country who are predominantly Muslims. The association between religion and age at first marriage have been established in other studies (Mobolaji, *et al*., 2020, Amzat, 2020). It should be mentioned that religion leaders should preach against early marriage that do not favour the women folks in order to avert its menace.

The educational qualification of the women revealed that, early marriage has a high correlation with the women educational level. The higher the women educational qualification, the less the prevalence of early marriage. To this, policy initiatives that will ensure compulsory basic educational level for the girl child should be enforced at all states in Nigeria while challenges of insecurities which has led to drop out of many school age children should receive serious attention of the government at all levels (Lawal, 2018; Adams, *et. al*, 2021; Ojo, 2021).

The timing of the onset of sexual intercourse is found to significantly affect the age at marriage. Reda and Lindstrom, 2014 established in their work that that women who have first sexual intercourse before marriage are delaying marriage more than was the case among other women. This also show that women who are exposed to sex earlier than in marriage delays the timing for marriage compared to other women.

The region of residence of the women contributes significantly to the ages at which marriage is initiated, women from the Northern region of the country were found to initiate marriage at an early age more than women from other regions, this was also shown for the map of the country showing the ages at which half of the population of women marries across the states (Islam, et al., 2016, Nmadu, et al., 2018).

CONCLUSION

The study was carried out on age at first marriage among Nigeria women using dataset from 2018 Nigeria Demographic and Health Survey (NDHS). For the study, a Cox

model with two additive random effect was incorporated to account for the effect of the individual women nested in the state.

It was revealed from the findings that women residing the rural part of the country are prone to early marriage. The economic capacities of the women also indicates that women who are characterised as poor are more exposed to early marriage than women who are economically stable. A holistic strategy which includes awareness, change in behaviour and implementation of laws and policies is needed in putting an end to early marriage, particularly child marriage in the Northern part of Nigeria. The findings suggests that the hazard of early marriage decreases with increasing age of the respondents (current age), which implies that earlier cohorts of women were less likely to marry earlier compared with younger cohorts of women.

One finding which is of interest and of great concern is that women who initiated sex before marriage had a decreased hazard to early marriage compared to women who initiated sex at marriage. State heterogeneity was found to have highest contribution to age at marriage. It was also found that location of residence within the state has heterogeneity that contribute to the model. This implies that women in the rural areas are more prone to early marriage than their counterpart in the urban areas. From the findings, early marriage is seen not be a general phenomenon in Nigeria but more of a regional issue as the location and state of residence (region) were found to be significant in determining the timing of marriage.

The factors considered to affect the timing for marriage in this work have been limited to socio-demographic and economic factors of women in their reproductive age, future studies should consider factors relating to ethnicity and the different cultural backgrounds in the country. This is necessary because of the numerous ethic groups and dialects in the country, this will further reveal the socio-cultural variation in the timing for marriage among Nigeria women.

ETHICAL APPROVAL

Permission to use data from NDHS 2018 was obtained through online registration with Macro International Incorporation via the DHS website (www.measuredhs.com). Respondent confidentiality was intact as no names and addresses were included in the data set and therefore the respondents cannot be traced by the researcher.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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